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APPLIED RESEARCH ON PINE GUM AT THE NAVAL STORES STATION [1]

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An industry which supports 400,000 people in a region of forests, farms, and small towns, extending less than 500 miles from end to end, is obviously vital to the economy of that region. This is the case of the naval stores industry. Yet the naval stores industry was operated entirely by trial and error and on the crudest type of equipment for over 300 years.

Until about 1930 the production of turpentine and rosin was the work of 1100 fire stills. Timber owners or lessors of timber gathered the crude gum in the woods, dumped it directly into a copper kettle over a direct fire, and processed it into turpentine and rosin which they shipped for sale elsewhere. The still setting was of the simplest possible construction, since operations moved from place to place every few years as the timber was exhausted. There was no centralization of the enterprise and every operator had his personal manner of conducting it. What is more, this rule-of-thumb method of processing was passed down as gospel through generations of fathers and sons without ever the slightest question raised as to its complete satisfactoriness. The methods of processing were themselves faulty and wasteful, particularly in the quality of the rosin produced. It was estimated that from a 40-million dollar crop 2 million dollars in turpentine and 6 million dollars in rosin was lost between the producing pine tree and the finished product.

This was the situation in the industry in 1931 when the Naval Stores Station was established at Olustee, Florida. The purpose of this Station is to work out on a practical operating basis problems encountered in the production of naval stores and their derivatives. The Naval Stores Station is the engineering pilot-plant of the Naval Stores Research Division of the Bureau of Agricultural and Industrial Chemistry of the Department of Agriculture.

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[1] A report of a study in which certain phases were carried out under Research and Marketing Act of 1946.

[2] The Naval Stores Station is a part of the Naval Stores Research Division of the Southern Regional Research Laboratory.

The establishment of the Naval Stores Station was the climax of a program of technological assistance to the naval stores industry by the Department of Agriculture begun in 1911 by C. F. Speh and V. E. Grotlisch in the Bureau of Chemistry and Soils and continued after 1923 by G. P. Shingler. As a Department naval stores technologist Mr. Shingler visited the scattered fire stills, and recommended and demonstrated better methods of processing with the equipment available. When the Naval Stores Station was established, Mr. Shingler was placed in charge, and remained at its head until his retirement year, 1949.

Entirely because of work at the Naval Stores Station between 1935-45, processing methods in gum naval stores were completely reorganized. Within 4 years after the Station began research, the effects of stilling practices on the quality of the turpentine and rosin had been evaluated and the average values determined for the turpentine and rosin contents of commercial crude pine gum. Chemical and engineering studies made on methods for removal of dirt and trash from crude gum led to the now widely used "Olustee Process" of gum cleaning. Attacks were made on other phases of gum handling and processing to meet modern criteria of mass production, economy, and quality.

The Industry is Revolutionized

Some specific contributions of the Naval Stores Station which assisted in this processing revolution are described.

Spread of Central Plants

Directly as a result of Naval Stores Station research, the practice of processing pine gum at central plants spread rapidly. The first central plant for the mass collection and distillation of pine gum was opened in 1934 in Jacksonville, Florida. By 1941 central plants were processing 33 percent of the total rosin and turpentine. In 1947 central plants processed 88 percent of the total United States naval stores. In the naval stores year ending March 31, 1949, central plants processed 90 percent of total domestic production.

The 28 central processing plants are located at intervals of about 50 miles over an area bounded by Savannah, Macon, and Columbus, in Georgia: by Mobile, Alabama: and by Jacksonville, Florida. To obtain operating volume, the central plants buy for cash crude gum delivered to the still. The ready market for crude gum has been of particular value to intermediate producers who do not produce enough gum to operate a fire still, yet can sell enough gum to the central stills to provide for their full-time employment. Cash payments by central stills provide much of the farmer's off-season income for the surrounding territory. One such still paid 1.2 million dollars in 1948 for 48,000 barrels of crude gum; a larger plant bought 75,000 barrels, distributing 1.9 million dollars among 1700 customers.

The Role of Gum Cleaning

The foundation for the expansion of the central plant system was the development by the Naval Stores Station of the "Olustee Process" of gum cleaning. A public service patent on this process was issued to members of the staff in 1941 and assigned to the Secretary of Agriculture, the payment of royalties for its use being thus unnecessary. The Olustee process makes it possible for a central plant to process 1,000 barrels of crude gum per week, compared with the fire still's capacity of 180 barrels per week. Moreover, the Olustee process increases the yield of rosin by 5 percent above fire still returns. Of the 28 central plants in operation in 1949, twenty-seven use the Olustee process.

Technological Assistance

The most direct assistance the Naval Stores Station offers to the processing industry is technological help at the plants in connection with the operation of the Olustee process. With so large a proportion of the central plants licensed to use the process the Naval Stores Station has necessarily concentrated most of its attention on technical assistance and on projects of direct benefits to such plants. At a processor's request, a member of the Station staff looks over the plant for operating troubles and makes recommendations for more efficient operation. He distributes information on the correct use of oxalic acid to remove iron stain from gum to produce clean rosin, on the proper dehydration and recycling processes to produce high-quality turpentine, and on ways of reclaiming wastes from plant operation. In a typical period — April 1, 1948 to March 31, 1949 — two members of the Station staff made 77 advisory visits to central plants.

In exchange the Naval Stores Station staff receives benefits from central plant operators. The interchange of ideas on commercial operation of the Olustee process provides useful information to apply in new research developments.

Engineering advice as rendered to central plants by the Naval Stores Station — of such great benefit to the processor and through him to the customers he serves — has been necessary since so few of the central plants as yet employ their own professional chemist or chemical engineer.

Standard Marketing Methods

A prerequisite to the collection and processing of crude gum in the large quantities handled at central plants was the establishment of standard turpentine and rosin contents for crude gum. The publication by the Naval Stores Station in 1937 of average yields of turpentine and rosin in a 435-pound net weight barrel of gum provided a firm basis for the sale of the crude gum on estimated yields before distillation. This is the system by which gum is now universally bought and sold.

The Naval Stores Station occasionally acts as referee in determining yields of crude gum, running check charges on their fire still to determine rosin grades and yields of turpentine and rosin for the interest of the seller and buyer.

Research on Distillation Processes

Another line of work in plant operation has been as widely accepted as the Olustee process itself. This is the development of steam distillation of pine gum. Fire stills have been almost entirely displaced by steam stills. Central processing and application of Olustee gum cleaning would not otherwise be practicable.

Continuous steam distillation to replace batch processes has been under investigation at the Naval Stores Station since 1944. Continuous distillation would have the advantage of lowering fuel and labor costs. The Station engineers have developed a successful continuous still which has about half the capacity of turpentine and rosin production of present commercial stills. A redesigned continuous still of commercial size has been constructed and is now being tested.

New Derived Products from Turpentine and Rosin

Despite the many radical improvements in processing, the old markets for turpentine and rosin have been progressively lost to substitute materials. Particularly have the industrial markets of turpentine dwindled in recent years — only 6 percent of the total consumption was reported in 1948 in industrial uses, in contrast to about 75 - 80 percent in the past. Diminished markets, of course, affect producers, processors, and dealers alike.

The accepted practice is to sell turpentine and rosin as raw materials for further processing. Modernized processing methods open up limitless possibilities of crude gum as a storehouse of industrially promising chemicals. Only in the development of such new products can new markets for pine gum be found.

The fundamental and technological sections of the Naval Stores Research Division at the Southern Regional Research Laboratory in New Orleans, Louisiana, work, respectively, to develop new compounds from gum naval stores and new uses for these compounds. Through funds made available from the Research and Marketing Act of 1946, several promising compounds are being developed from pine gum by the Division. The first of these research-discovered products to reach the Naval Stores Station for pilot-plant development is a crystalline compound derived from one of the rosin acids in crude gum — the maleic anhydride adduct of laevo-pimaric acid. This adduct shows possibilities for use in paper coatings, varnishes, and in the manufacture of synthetic rubber.

The pilot-plant process for producing the adduct begins with crude gum, which is diluted with turpentine and filtered. Water is removed from the cleaned gum, and the gum is reacted with maleic anhydride at a moderate temperature. On cooling, the crystalline adduct separates from the liquid and is centrifuged, washed, and dried. After the adduct has been recovered, the turpentine content of the diluted gum, plus the remaining rosin, is reclaimed by distillation. This process of recovery of the filtrate from the adduct preparation will be designed to operate as part of the central plant system. Small batches of the adduct have been prepared in the Station pilot plant and a production line is being assembled.

Industry Practice Must Follow Up Research

The gum naval stores processing industry has not yet been completely modernized. One step, for instance, which the industry can take for itself to ensure its future is the practice of product quality control in the speeded up distillation processes.

Government research is doing much to secure the industry against waning markets. But research alone, however successful, can never entirely accomplish this. Only if the industry decisively acts to follow up research by practice can it place itself on a level with other competitive industries.

When an industry supports 400,000 people in a region of forests, farms, and small towns, its successful operation is vital to the continuing economic welfare of that area. Government research in naval stores has paid off — to the processors, who have a new processing industry: to the farmers and timber operators, who have a competitive cash market: and to the thousands of business men whose success is dependent on continuing farm income. Successful development of new products from pine gum promises further advantages.

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